1 May 1969

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

RESPIRATORS

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to establish a uniform procedure for determining and evaluating the technical performance and safety aspects of air filtering respirators in terms of the criteria established by applicable Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), Technical Characteristics (TC's) and other design requirements and specifications.

2. BACKGROUND

Respirators are air filtering respiratory protective devices designed to remove solid particles and organic vapors from air before it is inhaled. Wearers are protected from pneumoconiosis-producing and nuisance dusts and mists; toxic dusts, mists and fumes, and radionuclides; organic vapors; and paint, lacquer, and enamel mists. Respirators with attached chemical cartridges provide protection against light concentrations of poisonous gases but are not intended for protection against chemical, biological, or radiological (CBR) agents or in oxygen-deficient atmospheres.

This MTP covers aerosol- and chemical-cartridge types B and BE air filtering respirators. Type B respirators are used for protection against organic vapors such as acetone, alcohol, benzene, carbon tetrachloride, ether, formaldehyde, gasoline, petroleum distillates, and toluene. Type BE respirators protect against organic vapors in combination with dusts, fumes, and mists, including aerosol from paint-spraying operations. The type letter E indicates protection against particulate contaminants.

Respirators equipped with particulate filters do not protect against gases and vapors nor against an atmosphere deficient in oxygen. Respirators should not be used in enclosures where a heavy buildup of contaminated air is possible, or where the atmosphere is deficient in oxygen or where the atmosphere contains more than 0.1 percent of organic vapor by volume (1000ppm).

3. REQUIRED EQUIPMENT

a. Environmental Test Chambers:

1) Temperature and humidity
2) Dust
3) Fungus
4) Solar Radiation
5) Salt Fog
6) Rain
7) Water immersion

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b. Leak Test Facility.
c. Bituminous Coal Dust capable of passing through 200 mesh wire screen.
d. Activated-Charcoal-Filled Canister or Cartridge.
e. Head Form and Mechanical Breather.
f. Manometer.
g. Test Materiel as required:

1) Silica dust (90% and 99% free silica)
2) Lead dust
3) Oxygen gas flame source and molten lead
4) Chromic acid
5) Carbon tetrachloride
6) Atomizer
7) Uranine
8) Dioctyl pthalate (DOP)
9) Test aerosols:

a) Lead paint mist
b) Lacquer mist
c) Enamel mist

4. REFERENCES

A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
B. AR 705-2, Research and Development of Materiel: Documenting Test Plans and Reports.
C. AR 750-6, Maintenance of Supplies and Equipment: Supply Planning.
D. MIL-STD-105, Sampling Procedures and Tables for Inspection by Attributes.
E. MIL-STD-803, Human Engineering Criteria for Aerospace Systems and Equipment: Part I: Ground Equipment.
F. MIL-STD-810B, Environmental Test Methods.
G. MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
H. MIL-H-46855, Human Engineering Requirements for Military Systems, Equipment, and Facilities.
I. Fed Specification TT-P-86, Paint, and Red-Lead Base, Ready-Mixed.
J. Fed Specification TT00-31-C, Lacquer, Cellulose, Nitrate, Gloss.
K. Fed Specification TT-Ear/89, Enamel, Alkyd, Gloss (for exterior and interior surfaces).
L. MTP 7-1-002, Air Portability and Airdrop Service Testing.
M. MTP 7-2-515, Air Transport (suitability of Equipment for).
N. MTP 8-2-500, Receipt Inspection.
O. MTP 8-2-503, Rough Handling and Surface Transport.
P. MTP 10-2-502, Durability.

5. SCOPE

5.1 SUMMARY

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This Materiel Test Procedure consists of the following subtests recommended for use to evaluate respirators.

a. Receipt Inspection - An inspection of the test item to (1) determine its physical characteristics and condition, (2) detect manufacturing errors, and (3) identify damage received during transport.

b. Safety Evaluation - The object of this test is to (1) ensure that adequate safety features have been incorporated in the test item's design (2) verify the safety statement issued by the developing agency, and (3) obtain data to be included in the safety release recommendation required by reference 4A (USATECOM Regulation 385-6).

c. Simulated Environmental Testing - A study conducted to determine the item's functional suitability under various environmental conditions, such as temperature extremes, humidity, fungus, sunshine, salt fog, rain, altitude, and dust.

d. Rough Handling and Surface Transport Testing - A study to determine the effects of rough handling and surface transport on the physical and operational characteristics of the test item.

e. Air transportability - A study to determine the ease of loading and unloading the equipment on and from aircraft.

f. Leak Testing - A study to determine whether the test item leaks when subjected to certain standard conditions.

g. Operational Characteristics - A series of tests to determine whether the test item possesses the desired operating characteristics.

h. Maintenance Aspects - A study to determine the test item's ease of maintainability.

i. Efficiency and Reliability Evaluation - An evaluation of experimental data to determine if the test item will operate efficiently and reliably when placed in the hands of troops.

j. Human Factors Evaluation - A study to determine if the test item has been designed to be used without excessive difficulties.

5.2 LIMITATIONS

The procedures described herein are not intended for testing field protective masks used to protect against CBR agents or for testing air/oxygen breathing apparatuses. See MTP's 8-2-110 and 8-2-113 respectively for test procedures for such items.

This MTP does not cover respirator outfits, portable respirators, or mobile respirator-type apparatus. This MTP covers only types B and BE respirators.

6. PROCEDURE

6.1 PREPARATION FOR TEST

6.1.1 Prescheduling Conditions

The test officer will verify the receipt of the test items and will determine the proper sequence of the various subtests in his test plan,

according to reference 4B (AR-705-2). The number of items that will be subjected to each test will be as specified by the procuring agency or in accordance with reference 4D (MIL-STD-105), or the minimum specified under test conduct.

The availability of the required equipment and facilities will be ascertained before test. All instrumentation will be calibrated and certified prior to use.

6.1.2 Safety Statement

The test officer will ensure that a safety statement is received from the developing agency before testing is initiated and that it is understood by all test personnel. The safety statement includes information pertaining to the test item's operational limitations and specifies hazards peculiar to the item or components which are to be tested.

6.1.3 Personnel Safety

The test officer will acquaint himself with all possible safety hazards. Preliminary safety evaluation tests shall be performed when the test officer feels these are necessary before the safety of the test to personnel can be verified. All support and test personnel will be informed of hazards associated with the tests. Fire fighting, resuscitation, and safety equipment will be available and in readiness during all tests.

6.1.4 Security

Military and civilian test personnel associated with the tests will have the proper security clearance. All classified documents will be clearly marked and proper security precautions observed.

6.1.5 Logistical Requirements

Prior to the conduct of any subtest, the test officer will ensure that all logistical requirements are satisfied.

6.2 TEST CONDUCT

6.2.1 Receipt Inspection

Subject the test item to the applicable procedures of MTP 8-2-500, following its arrival at the test site, with emphasis on the following:

a. Visually inspect the test item containers, and record the following:

1) Damage (broken seals, dents, punctures, etc)
2) Rust or corrosion of metal
3) Illegible or missing markings
4) Incorrect labeling

b. Visually inspect the test item and record all deficiencies, specifically the following where applicable:

1) Missing components.
2) Incorrect assembly of components.
3) Body cracks or open body seams.
4) Cracked or scratched lenses.
5) Spring wires broken, missing or rusted.
6) Aluminum contour strip broken or missing.
7) Jersey knit cloth mildewed or rotted.
8) Webbing inelastic or mildewed.
9) Fasteners, slides or clasps inoperative or corroded.
10) Improper contents of canister/cartridge or improper color code.
11) Missing filters.
12) Sticky valves.
13) Deterioration of rubber parts, such as cracks, excessive bloom, stickiness, or sponginess.

c. Serially number and identify each test item to be used.
d. Determine and record the following:

1) External dimensions and weight of packaged item
2) External dimensions and weight of test item

e. Determine if the test item leaks by performing the applicable procedures of paragraph 6.2.6.
f. Determine the operating characteristics of the test item by subjecting it to the applicable procedures of paragraph 6.2.7.
g. Photograph the defective item.

6.2.2 Safety Evaluation Test

a. Perform tests as required to verify all the safety aspects included in the safety statement prepared by the developing agency.
b. Collect data to be included in the safety release recommendation required to reference 4A (USATECOM Regulation 385-6).

6.2.3 Simulated Environmental Testing

6.2.3.1 Cyclic Storage

Subject the test item to the long-term storage test of MTP 8-4-004 or the following:

a. Subject the test item in its packing container to cycles of climatic extremes. A cycle shall consist of three weeks duration as follows: Successive one week tests at humid, low temperature, and high temperature. Chamber conditions for each climatic condition are as follows:

1) Humid Storage. The chamber shall be maintained at 113°F

± 2°F and 85% R.H. for the duration of the test.

2) Low Temperature Storage. The chamber shall be maintained at -65°F ± 2°F for the duration of the test.
3) High Temperature Storage. The chamber shall be maintained at 160°F ± 2°F for the duration of the test.

b. The test item shall be subjected to a minimum of three such cycles, or more if specified. Upon completion of each cycle, the container and contents shall be examined for damage.

6.2.3.2 Extreme-Temperature Test

Unless otherwise directed the test item shall be subjected to the following temperature tests:

6.2.3.2.1 Low-Temperature Test - Place a minimum of 6 test items which have successfully passed the tests of paragraph 6.2.1 in a test chamber, and perform the following:

a. Reduce the chamber temperature of -45.6°C (-50°F), maintain it at -45.6°C for a period of 72 hours, and then visually inspect the test items and record any damage.

b. Raise the chamber temperature to the test item's minimum operating temperature as established by design requirements, and maintain this temperature until stabilization is reached. If stabilization is attained in less than 24 hours, maintain temperature for a complete 24-hour interval. Perform the following:

NOTE: Stabilization, unless otherwise specified, is considered to be reached when the temperature of the test item does not change more than 2°C (3.6°F) per hour.

1) Visually inspect the test item, and record damage.
2) Remove 1/3 of the test items, and verify operability by the applicable procedures of paragraph 6.2.7.

NOTE: Operability checks should be accomplished within 15 minutes or removing the test items from the chamber.

c. Remove the items from the chamber. Bring them to room temperature and perform the following:

1) Visually inspect the test items and record damage.
2) Subject ½ of the test items to the applicable leak test procedures of paragraph 6.2.6.
3) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.2.2 High-Temperature Test - Place a minimum of 2 test items which have successfully passed the test of paragraph 6.2.1 in a temperature chamber, and perform the following:

a. Adjust the temperature of the chamber to 71.7°C (160°F) and a

relative humidity of 15 percent, and maintain these conditions for a minimum of 4 hours, then visually inspect the test items and record any damage.

b. Adjust the chamber to the test item's maximum operating temperature and to a relative humidity of no more than 15 percent, and maintain these conditions for a minimum of 24 hours. Then perform the following:

1) Visually inspect the test items, and record any damage.
2) Subject ½ of the test items to the applicable leak test procedures of paragraph 6.2.6.
3) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.3 Fungus Test

a. Subject a minimum of 6 test items to the procedures of Procedure I, Method 508, of reference 4F (MIL-STD-810B).

b. At the completion of the exposure period, perform the following:

1) Visually inspect the items, and record any signs of corrosion.
2) Disassemble 1/3 of the test items, and inspect the components for the presence of fungus.
3) Subject 1/3 of the test items to the applicable leak test procedures of paragraph 6.2.6.
4) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.4 Humidity Test

a. Subject a minimum of 6 test items to Procedure I, of Method 507, of reference 4F (MIL-STD-810B).

b. At the completion of the cycling period, perform the following:

1) Visually inspect the items, and record any signs of corrosion and/or deterioration.
2) Disassemble 1/3 of the test items, and inspect the components for corrosion and/or deterioration.
3) Subject 1/3 of the test items to the applicable leak test procedures of paragraph 6.2.6.
4) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.5 Dust Test

a. Subject a minimum of 6 test items to exposure conditions of Procedure I, Method 510, of reference 4F (MIL-STD-810B).

b. At the completion of the exposure period, perform the following:

1) Visually inspect the test items, and record any surface damage or wear.

2) Disassembly 1/3 of the items and inspect the components for damage and presence of dust.
3) Subject 1/3 of the test items to the applicable leak test procedures of paragraph 6.2.6.
4) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.6 Sunshine Test

a. Subject a minimum of 4 test items to Procedure I, of Method 505, of reference 4F (MIL-STD-810B).

b. At the completion of the exposure period, perform the following:

1) Visually inspect the test items, and record surface damage noted, i.e. deterioration of rubber and plastics.
2) Subject ½ of the test items to the applicable leak tests of paragraph 6.2.6.
3) Verify the operability of the test items by subjecting the remaining test items to the applicable procedures of paragraph 6.2.7.

6.2.3.7 Water Immersion Test

a. Subject a minimum of 6 test items, in their packing cases, to Procedure I, of Method 512, of reference 4E (MIL-STD-810B).

NOTE: If design requirements establish depth of water, water temperature, or time of immersion different from the standard procedure, the test plan will so state.

b. At the completion of the immersion test, remove the test items from their containers, and perform the following:

1) Disassemble 1/3 of the test items, and inspect their components for evidence of water penetration.
2) Subject 1/3 of the test items to the applicable leak test procedures of paragraph 6.2.6.
3) Verify the operability of the test items by subjecting the remaining test items to the procedures of paragraph 6.2.7.

c. If required by the item's specifications, repeat steps a and b with a minimum number of unpacked test items.

6.2.3.8 Salt Fog Test

a. Subject a minimum of 6 test items to Procedure I, of Method 509, of reference 4F (MIL-STD-810B).

b. At the completion of the salt fog spray exposure, perform the following:

1) Rinse the test items with clear water.
2) Visually inspect the test items for the presence of corrosion.
3) Disassemble 1/3 of the test items, and inspect their com-

ponents for evidence of water penetration and corrosion.
4) Subject 1/3 of the test items to the applicable leak tests of paragraph 6.2.6.
5) Verify the operability of the test items by subjecting the remaining items to the applicable procedures of paragraph 6.2.7.

6.2.3.9 Rain Test

a. If required by the test item specifications, subject a minimum of 4 test items to Procedure I, Method 506, reference 4F (MIL-STD-810B).
b. At the completion of the rain exposure, perform the following:

1) Visually inspect the test items for the presence of corrosion.
2) Disassemble ½ of the test items, and inspect their components for evidence of water penetration.
3) Verify the operability of the test items by subjecting the remaining items to the procedures of paragraph 6.2.7.

6.2.4 Rough Handling and Surface Transport Tests

a. Subject a minimum of 4 test items, packaged in their original containers, to the following procedures of MTP 8-2-503:

1) Vibration test of paragraph 6.2.2.2a.3
2) Transit drop test of paragraph 6.2.2.1a.2

b. At the completion of testing, perform the following:

1) Examine the test item's packaging for cracks, breaks, undone binding, etc.
2) Examine the test items for damage and/or deterioration.
3) Subject ½ of the test items to the applicable leak tests of paragraph 6.2.6.
4) Verify the operability of the test item by subjecting the remaining items to the applicable procedures of paragraph 6.2.7.

6.2.5 Air Transportability

Determine the ease of loading and unloading the test items from an aircraft as described in the applicable sections of MTP 7-2-515 or as follows:

NOTE: Background information on air transportability is contained in MTP 7-1-002.

a. Load the test items, in their shipping containers, aboard a typical cargo aircraft or simulated aircraft, using current standard loading equipment, and record the following:

1) Type of aircraft used (or simulated)
2) Shipping container length, width, height, weight, and material

3) Equipment used for loading
4) Difficulties encountered while loading
5) Method of tiedown
6) Any damage sustained by the package during loading

b. Unload the test items from the aircraft or simulated aircraft, and record the following:

1) Equipment used in unloading
2) Difficulties encountered while unloading

6.2.6 Leak Tests

Subject the test item to the applicable leak test(s) described below. If more than the described tests are considered appropriate, subject the test item to the leak test(s) devised and/or specified by Combat Development Command or the test officer.

6.2.6.1 Facepiece Fitting Test

a. Fit the respirator to the faces of a suitable number of test personnel (15-20 persons recommended) having a wide variety of facial shapes and sizes. These persons will hold the exhalation valve shut without disturbing the fit of the respirator and will exhale gently into the facepiece. The absence of outward leakage of air between the facepiece and each wearer's face will indicate satisfactory fit of the facepiece.

b. Record the following:

1) Test item identification and serial number.
2) Number of test personnel in the test.
3) Record any difficulties encountered in obtaining a proper facepiece fit.

6.2.6.2 Facepiece Leak Test

a. A suitable number of the persons who participated in the test described in paragraph 6.2.6.1 of this section, each wearing the complete non-emergency gas respirator for protection against organic vapors, will enter an atmosphere containing 0.01 percent of volume (100 ppm) of isoamyl acetate vapor. Ten minutes will be spent in work designed to provide observation on freedom from leaks, freedom of movement, and freedom from discomfort to the wearer. The time will be divided as follows:

1) Five minutes - Walking, moving head from side to side, nodding and bending the body at the waist.
2) Five minutes - Pumping air with a hand-operated tire pump into a 1-cubic-foot cylinder to a pressure of 25 pounds per square inch gage, or equivalent work.

b. To meet the requirements of this test, no isoamyl acetate will be detected by odor in the air breathed, and undue encumbrance and discomfort will not be experienced because of the fit or other features of the respirator.

c. Record the following data:

1) Test item identification and serial number.

2) Number of test items used in test.
3) Chamber conditions (standard ambient conditons).
4) Organic vapor used during test.
5) Type of activity of test personnel during test.
6) Complaints, if any, of detected odor in the air breathed, undue encumbrance, and discomfort.

6.2.6.3 Coal-Dust Tightness Test

NOTE: This test is applicable to respirators designed for respiratory protection against dusts and mists of materials having a threshold limit value (TLV) of not less than 0.1 milligram per cubic meter or 2.4 million particles per cubic foot. The TLV for each substance will be the most recent value established by the American Conference of Governmental Industrial Hygienists.

a. A suitable number of test subjects (10 to 20) having full, average, and lean facial features, will wear the respirators with suitable eye protection while a high concentration of finely divided bituminous coal dust (through 200-mesh) is blown gently into their breathing zones for a minimum of 3 minutes. At the end of this period, the excess dust will be removed from the periphery of each facepiece, after which the facepiece will be carefully removed from the face of each subject. To meet the requirements of this test for each of the test subjects, the following must not show appreciably more black particulate matter than was observed before test:

1) The forced nasal discharge, as shown on a white cloth and the sputum.
2) The breathing passages examined with the aid of a speculum and illumination.
3) That part of the face covered by the facepiece of the respirator.

b. Record the following data:

1) Test item identification.
2) Number of test item used.
3) Size of coal dust used.
4) Duration of test.
5) Room temperature.
6) Any evidence of coal dust penetration into mask and breathing passages of test subjects.
7) The variations of face sizes of the test subjects, and any difficulties experienced during the test.

6.2.6.4 Isoamyl Acetate Tightness Test

a. This test is applicable to respirators designed for respiratory protection against fumes of various metals having a TLV not less than 0.1 milligram per cubic meter. The respirator will be modified in such a manner that all of the air that nor lly would be inhaled through the inhalation port(s) is drawn through an efficient activated-charcoal-filled canister or cartridge(s) without interference with the face-contacting portion of the facepiece. Modified in this manner, the facepiece will be worn by a suitable number of persons

(10 to 18) for at least 2 minutes each in a test chamber containing 100 parts (by volume) of isoamyl acetate vapor per million parts of air. To meet the requirements of this test, the odor ofisoamyl acetate must be be detected by the subjects while wearing the modified respirator in the test atmosphere.

b. This test is applicable to respirators designed for respiratory protection against dusts, fumes, and mists having a TLV less than 0.1. The respirator will be modified as for the test of paragraph 6.2.6.4a and will be worn by a suitable number of persons (10 to 18) for 5 minutes in a test chamber containing isoamyl acetate vapor. Each person will spend 2 minutes walking, nodding, and shaking his head in normal movements and 3 minutes exercising and running in place. To meet the requirements of this test, the facepiece shall be capable of adjustment, according to the manufacturer's instructions, to each subject's face so that the odor of isoamyl is not detectable by any test subject.

NOTE: The concentration of isoamyl acetate in the chamber will be as follows:

1. 1000 parts (by volume) of the vapor per million parts of air where the contaminant concentration is known not to exceed 100 ppm or 1000 times the TLV or 100 ppm or 1000 times the concentration limits for radionuclides to be filtered.
2. 100 parts (by volume of the vapor per million parts of air where the contaminant concentration is known not to exceed 10 times the TLV or 10 times the concentration limits for the radionuclides to be filtered.

c. Record the following:

1) Test item identification
2) Number of personnel involved in test
3) Chamber temperature
4) Test vapor used
5) Test vapor concentration
6) Type of test activity performed by test subjects
7) Any odor detected by test personnel
8) Any difficulties experienced during test

6.2.7 Operational Tests

The test i em will be subjected to the applicable operational test(s) described below and to all other tests specified by the procurement agency and/or test officer.

6.2.7.1 Flow Test

a. Mount the complete respirator on a head form which is connected to a mechanical breather. Measure the inhalation/exhalation resistance to a continuous flow of air, at a rate of 85 liters per minute. The following inhalation/exhalation resistances are listed for type B and type BE respirators respectively:

1) Type BE:

a) Exhalation--25 millimeters (1 inch of water)
b) Inhalation--76 millimeters (3 inches of water)

2) Type B:

a) Exhalation--25 millimeters (1 inch of water)
b) Inhalation--50 millimeters (2 inches of water)

b. Record the following test data:

1) Test item's identification and serial number
2) Number of respirators used in test
3) Rate of air flow (liters/minute)
4) Inhalation resistance (inches of water)
5) Exhalation resistance (inches of water)
6) Ambient temperature, pressure and relative humidity conditions

6.2.7.2 Silica-Dust Filter Test

Respirators designed for protection against silica dust, having a TLV not less than 2.4 million particles per cubic foot, will be subjected to the following tests:

a. Single-use filters. A minimum of 6 respirators will be subjected, on a mechanical testing apparatus, to the following controlled conditions:

1) Relative humidity - 20 percent.
2) Room temperature - 25°C, approximately.
3) Rate of continuous air flow - 32 liters per minute.
4) Test suspension (for three respirators) - not less than 50 nor more than 60 miligrams of flint (90+percent free silica) per cubic meter of air. The flint will be ground to pass 99+ percent through a 325-mesh sieve; the particle-size distribution of the test suspension will have a geometric mean of 0.4 to 0.6 micron, and the standard geometric deviation will not exceed 1.96.
5) Duration of sampling period - 90 minutes for each respirator.

NOTE: Tested under these conditions, the total amount of unretained test suspension must not exceed a total of 4.5 milligrams for three respirators not more than 2 milligrams for any single respirator.

b. Reusable filters. A minimum of 6 respirators with filter elements designed for cleaning and reuse will be subjected to the tests described in paragraph 6.2.7.2a. Each filter element will be tested three times: once as received, once after cleaning, and once after recleaning. The manufacturer's instructions for cleaning the filter element will be followed, once for each of the three tests.

NOTE: Tested under these conditions, the total amount of unretained test suspension must not exceed a total of 4.5 milligrams for the three tests on any single respirator nor more than 2 milligrams for any single test.

c. Record the following for the single-use and reusable filters, when applicable:

1) Test item identification
2) Number of test items tested
3) Room temperature and relative humidity
4) Rate and type of flow
5) Concentration of silica suspension
6) Duration of test
7) Total amount of unretained test suspension (milligrams)

6.2.7.3 Lead-Dust Filter Test

Respirators designed for protection against lead dust having a TLV not less than 0.1 milligram per cubic meter will be subjected to the following test:

a. Single-use filters. A minimum of 3 respirators will be subjected on a mechanical-testing apparatus to the following controlled conditions:

1) Relative humidity - 20 percent.
2) Room temperature - 25°C approximately.
3) Rate of continuous air flow - 32 liters per minute.
4) Test suspension - not less than 15 nor more than 20 milligrams of lead (Pb) per cubic meter of air in a test suspension of National Lead Company's negative battery mixture no. 111-R, which has the following approximate composition: litharge, 75 percent; free metallic lead, 25 percent; carbon black, blanc fixe, and organic matter for expander purposes, 0.25 - 0.3 percent. The particle-size distribution of the test suspension will have a geometric mean of 0.4 to 0.6 micron, and the standard geometric deviation will not exceed 1.96.
5) Duration of sampling period - 90 minutes for each respirator.

NOTE: Tested under these conditions, the total amount of unretained test suspension, which is analyzed and calculated as lead (Pb), must not exceed 0.43 milligram of lead for any single respirator.

b. Reusable filters. A minimum of 3 respirators with filter elements designed for cleaning and reuse will be subjected to the tests described in paragraph 6.2.7.3a. Each filter element will be tested three times: once as received, once after cleaning, and once after recleaning. The manufacturer's instructions for cleaning the filter element will be followed once for each of the three tests.

NOTE: Tested under these conditions, the amount of unretained test suspension, which is analyzed and calculated as lead (Pb), must not exceed 0.43 milligram of lead for any single test.

c. Record the following:

1) Test item identification.
2) Number of items tested.
3) Room temperature and relative humidity.
4) Type and rate of air flow.
5) Type and concentration of test suspension.
6) Duration of test.
7) Total amount of unretained test suspension after completion of test (milligrams).

6.2.7.4 Lead-Fume Filter Test

Respirators designed for protection against fumes of metals having a TLV not less than 0.1 milligram per cubic meter will be subjected to the following test:

a. A minimum of 3 respirators will be subjected on a mechanical-testing apparatus to the following controlled conditions:

1) Relative humidity - 20 percent.
2) Room temperature - 25°C approximately.
3) Rate of continuous air flow - 32 liters per minute.
4) Test suspension - not less than 15 nor more than 20 milligrams of freshly generated lead oxide fume, calculated as lead (Pb), per cubic meter of air. The fume will be generated by impinging an oxygen-gas flame on molten lead.
5) Duration of sampling period - 312 minutes for each respirator. Samples of the test suspension will be taken during this period for analysis.

NOTE: Tested under these conditions, the total amount of unretained test suspension, which is analyzed and calculated as lead (Pb), must not exceed 1.5 milligrams of lead for any single respirator.

b. Record the following:

1) Test item identification.
2) Number of items tested.
3) Room temperature and relative humidity.
4) Type and rate of air flow.
5) Type and concentration of test suspension.
6) Duration of test.
7) Total amount of unretained test suspension after completion of test (milligrams).

6.2.7.5 Silica-Mist Filter Test

Respirators designed for protection against mists of materials having a TLV not less than 2.4 million particles per cubic foot will be subjected to the following test:

a. A minimum of 3 respirators will be subjected on a mechanical-testing apparatus to the following controlled conditions:

1) Room temperature - 25°C approximately.
2) Rate of continuous air flow - 32 liters per minute.
3) Test suspension - not less than 20 nor more than 25 milligrams of silica mist, weighed as silica dust, per cubic meter of air, produced by spraying an aqueous suspension of flint (99+ percent free silica). The flint will be ground to pass 99+ percent through a 325-mesh sieve.
4) Duration of sampling period - 312 minutes for each respirator. Samples of the test suspension will be taken during this period for analysis.

NOTE: Tested under these conditions, the total amount of silica mist unretained, weighed as silica dust, must not exceed 2.5 milligrams for any of the three respirators.

b. Record the following:

1) Test item identification.
2) Number of items tested.
3) Room temperature and relative humidity.
4) Type and rate of air flow.
5) Type and concentration of test suspension.
6) Duration of test.
7) Total amount of unretained test suspension after completion of test (milligrams).

6.2.7.6 Chromic-Acid-Mist Filter Test

Respirators designed for respiratory protection against mists of materials having a TLV not less than 0.1 milligram per cubic meter will be subjected to the following test:

a. A minimum of 3 respirators will be subjected on a mechanical-testing apparatus to the following controlled conditions:

1) Room temperature - 25°C approximately.
2) Rate of continuous air flow - 32 liters per minute.
3) Test suspension - not less than 15 nor more than 20 milligrams of chromic-acid mist per cubic meter of air, which is analyzed and calculated as chromic acid containing 200-500 grams of chromic anhydride per liter.
4) Duration of sampling period - 312 minutes for each respirator.

NOTE: Samples of the test suspension will be taken during this period for analysis.

NOTE: Tested under these conditions, the total amount of unretained chromic acid, which is analyzed and calculated as chromic anhydride, must not exceed 1 milligram for any single respirator.

b. Record the following:

1) Test item identification.
2) Number of items tested.
3) Room temperature and relative humidity.
4) Type and rate of air flow.
5) Type and concentration of test suspension.
6) Duration of test.
7) Total amount of unretained test suspension after completion of test (milligrams).

6.2.7.7 Carbon Tetrachloride Vapor and Chemical Stability Cartridge Tests

NOTE: Cartridges must meet the requirements of the machine tests as described below. These tests are made on an apparatus that is constructed to allow the test atmosphere to enter the cartridge continuously at predetermined concentrations and rates of flow and that has means for determining the life of the cartridges. When two cartridges are used in parallel on a respirator, the tests will be performed with the cartridges arranged in parallel and the test requirements will apply to the combination rather than to the individual cartridges.

a. Carbon tetrachloride vapor test. Cartridges will be subjected to a flow of air containing 0.1 percent by volume carbon tetrachloride vapor as shown in Table I and must meet the following requirements:

1) A suitably determined number of cartridges tested at a flow rate of 32 liters per minute must last for at least 100 minutes each before the concentration of carbon tetrachloride in the filtered air rises to 0.0005 percent.
2) A suitably determined number of cartridges tested at a flow rate of 64 liters per minute must last for 50 minutes each before the concentration of carbon tetrachloride in the filtered air rises to 0.0005 percent.

b. The chemical stability of the cartridges under dry and humid conditions will be determined as follows:

1) A suitably determined number of cartridges will be treated at room temperature by passing carbon dioxide-free air of 25 percent relative humidity through them at a rate of 25 liters per minute for 6 hours.

2) A suitably determined number of cartridges will be treated at room temperature by passing carbon dioxide-free air of 85 percent relative humidity through them at a rate of 25 liters per minute for 6 hours.
3) After this treatment, the cartridges will be resealed as received, kept in an upright position at room temperature, and tested for chemical stability within 18 hours under the conditions given in Table I. The carbon tetrachloride content ratio in the filtered air must be less than 0.0005 percent.

TABLE I. Requirements for Tests

Subtest and Para. No.	Number of Cartridges[a]	Rate of Air Flow (Liters/-Minute)	Maximum Allowable Leakage (ppm CCl_4)	Minimum Life (Minutes)[b]
Low rate of flow, 6.2.7.7a.1)	3	32	5	100
High rate of flow, 6.2.7.7a.2)	2	64	5	50
Chemical Stability, 6.2.7.7b.	4	32	5	45

[a] This number refers to pairs of cartridges if two are used in parallel on one respirator.

[b] The values given for minimum life apply to each cartridge or to each pair of cartridges. Tests will be continued until the maximum allowable leakage occurs.

c. Record the following:

1) Test item identification.
2) Number of test items used in test.
3) Flow rate.
4) Vapor concentration in filtered air at the end of specified time.
5) Test time required for vapor concentration in filtered air to rise to 0.0005 percent.

6.2.7.8 Paint, Lacquer, and Enamel Mist Tests

NOTE: Cartridges containing or having attached to them filters for protection against mists of paints, lacquers and enamels will be tested to determine their ability to protect against the inhalation of organic vapors according to the requirements of

paragraph 6.2.7.7 and, in addition, will be tested under the following conditions:

1. A minimum of 3 respirators will be tested against each mist aerosol.
2. Temperature - room temperature, approximately 25°C.
3. Type of flow - continuous.
4. Rate of flow of aerosol to respirators - 32 liters per minute.
5. Rate of flow of air through test chamber - 20 to 25 air changes per minute.
6. Atomizer - Spraying Systems Company 1/4J pneumatic atomizing nozzle with setup 1A, or equivalent, operating at an air pressure of 10 psi gage.
7. Test aerosols - lead-paint mist, lacquer mist, and enamel mist.

a. Lead-paint mist - The test aerosol will be prepared by atomizing a mixture of eight volumes of red lead paint and one volume of mineral spirits. The red lead paint will conform essentially to Federal Specification TT-P-86, type I. The concentration of lead (Pb) in the test aerosol will be 95-125 milligrams per cubic meter. The test aerosol will be drawn to each respirator for a total of 312 minutes (equivalent to drawing 10 cubic meters of the test aerosol to each respirator.

NOTE: Under these test conditions, the total amount of unretained mist, analyzed and calculated as lead (Pb), must not exceed 1.5 milligrams for any one of the respirators.

b. Lacquer mist - The test aerosol will be prepared by atomizing a mixture of one volume of clear cellulose nitrate lacquer and one volume of lacquer thinner. The lacquer used will conform essentially to Federal Specification TT00-31-C. The concentration of cellulose nitrate in the test aerosol will be 95 - 125 milligrams per cubic meter. The test aerosol will be drawn to each respirator for a total of 156 minutes (equivalent to drawing 5 cubic meters of the test aerosol to each respirator).

NOTE: Under these test conditions, the total amount of unretained mist, weighed as cellulose nitrate, must not exceed 5 milligrams for any one of the respirators.

c. Enamel mist - The test aerosol will be prepared by atomizing a mixture of one volume of white enamel and one volume of turpentine. The enamel used will conform essentially to Federal Specification TT-E-489 (an enamel having a phthalic alkyd resin vehicle and a titanium dioxide pigment). The concentration of pigment in the test aerosol, weighed as ash, will be 95 - 125 milligrams per cubic meter. The test aerosol will be drawn to each respirator for a total of 312 minutes (equivalent to drawing 10 cubic meters of the test aerosol to each respirator).

NOTE: Under these test conditions, the total amount of unretained

mist, weighed as ash, must not exceed 2 milligrams for any one of the three respirators.

d. Record the following:

1) Test item identification
2) Number of test items involved in test
3) Room temperature
4) Type of flow
5) Rate of air flow
6) Test aerosol used
7) Amount of unretained mist after each test
8) Concentration of test aerosol

6.2.7.9 Uranine and Dioctyl Pthalate (DOP) Tests

a. Uranine chamber tests. The following test will be made on a minimum of 3 respirators: The complete respirator will be sealed in an air-tight manner to a head form which is so constructed that the air can be drawn through it from within the facepiece of the respirator. The head form, with respirator attached, will be placed in a test chamber through which is flowing an aerosol containing not less than 1 nor more than 2 milligrams of uranine per cubic meter of air. The particle-size distribution of the test suspension will have a geometric mean of 0.2 micron and the standard geometric deviation will not exceed 1.96. Air will be drawn into and expelled through the respirator by a breathing machine that simulates human breathing at the rate of 32 liters per minute with 18 inhalation-exhalation cycles per minute. Samples of the atmosphere within the facepiece will be taken during the inhalation phase of the breathing cycle. To meet the requirements of the above test, the respirator must perform in accordance with the following tolerance:

TABLE II. Uranine Chamber Test Requirements

Maximum Concentration[a]	Maximum Allowable Penetration (Pct of Ambient)	Maximum Allowable Average Penetration for 3 Tests (Pct of Ambient)
TLV x 10	1	0.5
TLV x 100	1	0.5
TLV x 1000	0.1	0.05

[a]For radionuclides, substitute concentration limit for TLV (threshold limit value).

b. Dioctyl pthalate filter tests. Filter units will be tested in an atmospheric concentration of 100 micrograms of DOP per liter of air at continuous flow rates of 32 and 85 liters per minute for a period of 5 to 10 seconds. Where filters are to be used in pairs, the flow rates will be 16 and 42.5 liters per minute, respectively, through a single filter. The filter will

be mounted on a connector in the same manner as used on the respirator. The total leakage for the connector and filter must not exceed 0.03 percent of the ambient DOP concentration at either flow rate.

6.2.8 Maintenance Aspects

Subject the test item to the applicable procedures of MTP 10-2-507 and the following:

a. Perform complete maintenance on the test item following scrupulously the instructions in the item's maintenance manual, the instructions in reference 4C (AR-750-6).

b. Record the following:

1) Ease of maintenance.
2) Need for special tools or skills.
3) Interchangeability of components.
4) Adequacy and accuracy of the maintenance instructions provided by the manufacturer.
5) Time required to perform maintenance.
6) Maintenance category of the test item.

c. Obtain and retain in the test file motion pictures showing assembly and disassembly of test items and any repair operations performed.

6.2.9 Efficiency and Reliability Aspects

a. Subject the test item to the applicable procedures of MTP 10-2-507 during the entire period of testing.

b. Maintain a test log throughout the test in which the following shall be recorded:

NOTE: Human factors will be considered in determination of the efficiency.

1) Total number of items tested
2) Number of malfunctioning or nonfunctioning items
3) The reason for malfunctions/nonfunctions, if known

6.2.10 Human Factors Evaluation

a. Determine the ease of usage and the functional effectiveness of the test item when employed by test personnel representing the fifth through ninety-fifth percentiles of the Army population. See reference 4E (MIL-STD-803), reference 4G (MIL-STD-1472), and reference 4H (MIL-H-46855).

b. Record the following for each test item:

1) Type of equipment and clothing worn.
2) Ease of donning respirator.
3) Time required to don respirator, in seconds.
4) Ease of breathing.
5) Comfort of equipment and adequacy of respirator fit.

6) Intelligibility of speech transmission if the respirator is equipped with a voice-emitting capability.
7) Compatibility of breathing apparatus and respirator with the clothing and equipment worn.
8) Visibility (with and without optical lenses) under various environmental conditions, when applicable.
9) Any comments on problems affecting the use of effectiveness of the breathing apparatus, such as fit of respirators and ease of replacing filter and cartridge elements.

c. Obtain still or motion photographs where ncessary.

6.3 TEST DATA

6.3.1 Receipt Inspection

a. Record the following:

1) Data collected as described in the applicable sections of MTP 8-2-500.
2) For each test item's package:

a) Evidence of damage
b) Rust or corrosion of metal
c) Illegible or missing markings
d) Incorrect labeling
e) Weight in pounds
f) Length, width, and height in inches

3) For each test item:

a) Test item identification number.
b) Missing components.
c) Evidence of damage or deterioration.
d) Inoperative components.
e) Improper contents of canister/cartridge or improper color code.
f) Weight in pounds.
g) Length, width, and height in inches.
h) Leakage data collected as described in paragraph 6.2.6.
i) Operability data collected as described in paragraph 6.2.7.

b. Retain all photographs.

6.3.2 Safety Evaluation Test

Record the following:

a. Any features which constitute a safety hazard
b. Results of verifying the safety statement
c. Information for inclusion in the safety release recommendation

6.3.3 Simulated Environmental Testing

6.3.3.1 Cyclic Storage

Record the following:

a. Test performed (cyclic storage, low temperature storage)
b. Test item identification number
c. Cycle number
d. Damage to:

1) Container
2) Test item

6.3.3.2 Extreme Temperature Tests

6.3.3.2.1 Low Temperature Tests -

Record the following for each test item, as applicable:

a. Test item identification number
b. For temperature of -45.6°C (-50°F):

1) Damages incurred

c. For test item's minimum operating temperature:

1) Temperatue in °C
2) Damages incurred
3) Operability data collected as described in paragraph 6.2.7

d. For ambient temperature:

1) Temperature in °C
2) Test item damage
3) Leakage data collected as described in paragraph 6.2.6
4) Operability data collected as described in paragraph 6.2.7

6.3.3.2.2 High Temperature Tests -

Record the following for each test item, as applicable:

a. Test item identification number
b. For temperature of 71.7°C (160°F):

1) Damages incurred

c. For test item's maximum operating temperature:

1) Temperature in °C
2) Damages incurred
3) Leakage data collected as described in paragraph 6.2.6
4) Operability data collected as described in paragraph 6.2.7

6.3.3.3 Fungus Test

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 508.
c. Evidence of fungus on test item.
d. Leakage data collected as described in paragraph 6.2.6.

e. Operability data collected as described in paragraph 6.2.7.

6.3.3.4 Humidity Test

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 507.
c. Evidence of corrosion and/or deterioration.
d. Leakage data collected as described in paragraph 6.2.6.
e. Operability data collected as described in paragraph 6.2.7.

6.3.3.5 Dust Test

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 510.
c. Wear and damage to test item.
d. Presence of dust in test item.
e. Leakage data collected as described in paragraph 6.2.6.
f. Operability data collected as described in paragraph 6.2.7.

6.3.3.6 Sunshine Test

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 505.
c. Evidence of deterioration to the test item.
d. Leakage data collected as described in paragraph 6.2.6.
e. Operability data collected as described in paragraph 6.2.7.

6.3.3.7 Water Immersion Tests

Record the following for each test item, as applicable:

a. Test item identification number.
b. During immersion:

1) Depth of over container, in inches
2) Water temperature in °F
3) Presence of bubbling, if any
4) Immersion time to bubbling, if any, in minutes
5) Total immersion time, in minutes

c. Evidence of water penetration and corrosion.
d. When applicable, leakage data as described in paragraph 6.2.6.

e. When applicable, operability data as described in paragraph 6.2.7.

6.3.3.8 Salt Fog Tests

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 509.
c. Evidence of corrosion on test item and salt water penetration.
d. Leakage data collected as described in paragraph 6.2.6.
e. Operability data collected as described in paragraph 6.2.7.

6.3.3.9 Rain Tests

Record the following for each test item as applicable:

a. Test item identification number.
b. Data as collected under the applicable sections of MIL-STD-810, Method 506.
c. Evidence of corrosion and moisture penetration.
d. Operability data collected as described in paragraph 6.2.7.

6.3.4 Rough Handling and Surface Transport Tests

Record the following, as applicable:

a. Test performed (shock, vibration)
b. Test item identification number
c. For test item package:

    1) Presence of cracks, breaks, etc.
    2) Undone binding

d. Evidence of damage and/or deformation to the test item
e. Leakage data collected as described in paragraph 6.2.6
f. Operability data collected as described in paragraph 6.2.7

6.3.5 Air Transportability

Record the following:

a. Type of aircraft used/simulated
b. Shipping container:

    1) Length, width and height, in inches
    2) Weight in pounds
    3) Material

c. Equipment used for loading
d. Difficulties encountered while loading

e. Method of tiedown
f. Damage sustained by the package while loading
g. Equipment used while loading
h. Difficulties encountered while unloading

6.3.6 Leak Tests

6.3.6.1 Facepiece Fitting Test

Record the following:

a. Test item identification number
b. Test item serial number
c. Number of personnel in the test
d. Difficulties encountered in obtaining a proper facepiece fit

6.3.6.2 Facepiece Leak Test

Record the following:

a. Test item identification and serial number.
b. Number of test items used in test.
c. Chamber conditions (standard ambient conditions).
d. Organic vapor used during test.
e. Type of activity of test personnel during test (walking, pumping air, etc.).
f. Complaints, if any, of detected odor in the air breathed, undue encumbrace, and discomfort.

6.3.6.3 Coal-Dust Tightness Test

Record the following:

a. Test item identification
b. Number of test items used.
c. Size of coal dust used, in microns.
d. Duration of test, in seconds.
e. Room temperature in °C.
f. Any evidence of coal dust penetration into mask and breathing passages of test subjects.
g. The variation of face sizes of the test subjects, and any difficulties experienced during the test.

6.3.6.4 Isoamyl Acetate Tightness Test

Record the following:

a. Test item identification.
b. Number of personnel involved in test.
c. Chamber temperature in °C.
d. Test vapor used.

e. Test vapor concentration in ppm.
f. Type of test activity performed by test subjects (walking, running in place, etc.).
g. Any odor detected by test personnel.
h. Any difficulties experienced during test.

6.3.7 Operational Tests

6.3.7.1 Flow Test

Record the following:

a. Test item identification number
b. Test item serial number
c. Number of respirators used in test
d. Rate of air flow (liters/minute)
e. Inhalation resistance (inches of water)
f. Exhalation resistance (inches of water)
g. Ambient temperature in °C
h. Barometric pressure in inches Hg
i. Relative humidity in percent

6.3.7.2 Silica-Dust Filter Test

Record the following, as applicable:

a. Filter used (single-use, reusable).
b. Number of items tested.
c. Room temperature in °C.
d. Relative humidity in percent.
e. Rate of air flow in liters per minute.
f. Concentration of silica suspension in milligrams per cubic meter of air.
g. Duration of test in minutes.
h. Total amount of unretained test suspension in milligrams.
i. For reusable filters, condition of filter element (as received, cleaned once, cleaned twice).

6.3.7.3 Lead-Dust Filter Test

Record the following, as applicable:

a. Filter used (single-use, reusable).
b. Number of items tested.
c. Room temperature in °C.
d. Relative humidity in percent.
e. Rate of air flow in liters per minute.
f. Concentration of lead in milligrams per cubic meter of air.
g. Duration of test in minutes.
h. Total amount of unretained test suspension in milligrams.
i. For reusable filters, condition of filter element (as received, cleaned once, cleaned twice).

6.3.7.4 Lead-Fume Filter Test

Record the following:

a. Test item identification.
b. Number of items tested.
c. Room temperature in °C.
d. Relative humidity in percent.
e. Rate of air flow in liters per minute.
f. Concentration of test suspension in milligrams per cubic meter of air.
g. Duration of test in minutes.
h. Total amount of unretained test suspension in milligrams.

6.3.7.5 Silica-Mist Filter Test

Record the following:

a. Test item identification.
b. Number of items tested.
c. Room temperature in °C.
d. Relative humidity in percent.
e. Rate of air flow in liters per minute.
f. Concentration of test suspension in milligrams per cubic meter of air.
g. Duration of test in minutes.
h. Total amount of unretained test suspension in milligrams.

6.3.7.6 Chromic-Acid-Mist Filter Test

Record the following:

a. Test item identification.
b. Number of items tested.
c. Room temperature in °C.
d. Relative humidity in percent.
e. Rate of air flow in liters per minute.
f. Concentration of test suspension in milligrams per cubic meter of air.
g. Duration of test in minutes.
h. Total amount of unretained test suspension in milligrams.

6.3.7.7 Carbon Tetrachloride Vapor and Chemical Stability Cartridge Tests

6.3.7.7.1 Carbon Tetrachloride Vapor Test -

Record the following for each test performed:

a. Test item identification.
b. Number of cartridges tested.
c. Rate of air flow in liters per minute.

d. Duration of test in minutes.
e. Concentration of vapor in filtered air at end of specified time in ppm.
f. Time required for vapor concentration in filtered air to reach 0.0005 percent in minutes.

6.3.7.7.2 Chemical Stability -

Record the following for each test performed:

a. Test item identification.
b. Number of cartridges tested.
c. Rate of air flow in liters per minute.
d. Relative humidity in percent.
e. Room temperature in °C.
f. Storage time in hours.
g. Concentration of vapor in filtered air at end of specified time in ppm.
h. Time required for vapor concentration in filtered air to reach 0.0005 percent in minutes.

6.3.7.8 Paint, Lacquer, and Enamel Mist Tests

Record the following for each aerosol used:

a. Test aerosol used (paint, lacquer, enamel)
b. Test item identification
c. Number of test items used
d. Room temperature in °C
e. Rate of air flow through test chamber in changes per minute
f. Rate of aerosol flow to respirators in liters per minute
g. Atomizer air pressure in psi
h. Concentration of aerosol base in milligrams per cubic meter
i. Duration of test in minutes
j. Total amount of unretained mist in milligrams

6.3.7.9 Uranine and Dioctyl Pthalate (DOP) Tests

Record the following as applicable:

a. Testing compound (Uranine, DOP).
b. Test item identification.
c. Number of test items used.
d. Rate of air flow in liters per minute.
e. Concentration of compound in milligrams/micrograms per cubic meter of air.
f. Uranine penetration in percent of ambient for:

1) Single test
2) Three tests

6.3.8 Maintenance

Record data collected as described in the applicable sections of MTP 10-2-507, and the following:

a. Ease of maintenance.
b. Need for special tools or skills.
c. Interchangeability of components.
d. Adequacy and accurancy of the maintenance instructions provided by the manufacturer.
e. Time required to perform maintenance tasks in minutes.
f. Maintenance category of the test item.

6.3.9 Efficiency and Reliability Aspects

Record the following:

a. Data collected as described in the applicable sections of MTP 10-2-507.
b. Total number of items tested.
c. Number of malfunctioning or nonfunctioning items.
d. Reason for malfunctions/nonfunctions, if known.
e. Efficiency of test item.

6.3.10 Human Factors Evaluation

a. Record the following for each test item:

1) Type of equipment and clothing worn.
2) Ease of donning respirator.
3) Time required to don respirator, in seconds.
4) Ease of breathing.
5) Comfort of equipment and adequacy of respirator fit.
6) Intelligibility of speech transmission if the respirator is equipped with a voice-emitting capability.
7) Compatibility of breathing apparatus and respirator with the clothing and equipment worn.
8) Visibility (with and without optical lenses) under various environmental conditions, when applicable.
9) Any comments on problems affecting the use or effectiveness of the breathing apparatus, such as fit of respirators and ease of replacing filter and cartridge elements.

b. Retain all photographs.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Receipt Inspection

a. Data collected as a result of this procedure shall be presented as indicated in the applicable portions of MTP 8-2-500.

b. The description of the item, number of items tested, and conditions upon receipt shall be presented in tabular form.

c. Results of the leak subtest and operational subtest shall be presented in narrative or other convenient form.

6.4.2 Safety Evaluation

a. A Safety Release Recommendation (USATECOM Regulation 385-6) shall be forwarded to U. S. Army Test and Evaluation Command within 30 days of the beginning of the test. The Safety Release Recommendation shall contain the following information: Special safety considerations on hazards to personnel and materiel (including developmental types of equipment as well as standard components used in assemblage of items being tested).

b. Data and comments relative to safety hazards observed during any phase of testing.

c. Comments relative to suggested safety improvements.

6.4.3 Simulated Environmental Testing

a. The results of the subtests conducted shall be presented in tabular or other suitable form.

b. The results of the operational check tests performed at the conclusion of the various environmental tests shall be presented in narrative or other suitable form.

6.4.4 Rough Handling and Surface Transport

a. The results of this subtest shall be presented as indicated in applicable portions of MTP 8-2-503.

b. Tables, photographs, narrative comments, or other suitable means of presentation shall be used to report the results.

6.4.5 Air Transportability

a. The results of this subtest shall be presented as prescribed in MTP 7-1-002.

b. Air transport conditions shall be reported in tabular or other convenient form.

c. Narrative comments, photos, etc., may be included, if required.

6.4.6 Leak Tests

The results of the subtests shall be presented in tabular and narrative form.

6.4.7 Operational Reliability

Data collected in accordance with paragraph 6.3.7 shall be submitted to a qualified reliability analyst for evaluation. Evaluated data shall be presented in tabular form, or as otherwise appropriate, supplemented by graphic or art presentations and narrative comments as required to substantiate conclusions.

6.4.8 Maintenance

a. The results of this subtest shall be presented as indicated in the applicable section of MTP 10-2-507.

b. Tables, photographs, narrative comments, or other suitable means of presentation shall be used to report the results.

6.4.9 Efficiency and Reliability Aspects

Indicate the number of the tests, number of successful performances, number of failures and malfunctions, and present an estimate of reliability based upon the analysis of recorded data.

6.4.10 Human Factors Evaluation

a. Data from this subtest shall be presented in tabular, narrative, or other suitable form supplemented by photographs and graphic or art presentations as required.

b. A summary of comments regarding shortcomings and recommended improvements shall be presented.

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13. ABSTRACT
This Engineering Test Procedure describes test methods and techniques for evaluating the technical performance and characteristics of Air Filtering Respirators related to the criteria established by applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

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